

## **Differential Mutagenicity and Lung Toxicity of Smoldering Versus Flaming Emissions from a Variety of Biomass Fuels**

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Wildfire smoke properties change with combustion conditions and biomass fuel types. However the specific role of wildfire conditions on the health effects following smoke exposure are uncertain. This study applies a novel combustion and smoke-collection system to examine emissions from multiple biomass fuel types (red oak, peat, pine needles, pine, and eucalyptus) firing under different combustion phases (flaming and smoldering). The combustion system sustains flaming or smoldering phase for up to 60 min and uses multi-stage, cryogenically cooled impingers to capture particulate matter (PM) and semi-volatile organic compounds from the smoke emissions. Biomass smoke PM was extracted and assessed for mutagenicity in *Salmonella* strains TA100 and TA98 +/-S9, as well as lung toxicity in mice via oropharyngeal aspiration. Carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), and PM concentrations monitored continuously during the combustion process were used to calculate modified combustion efficiency (MCE) and emission factors (EFs). Average MCEs were 73% during smoldering and 98% during flaming phases. Additionally, EF CO, EF CO<sub>2</sub>, and EF PM correlated well with MCE. On an equal-mass basis, the extractable organic matter from the peat, pine, and eucalyptus flaming PM had the highest mutagenic potencies; similarly, the lung toxic potencies of the peat and eucalyptus flaming PM were greater than those of respective smoldering PM. However, after adjusted for the emitted PM mass (i.e., real-life smoke exposure situations), the mutagenicity and lung-toxicity emission factors were higher for the smoldering than the flaming emissions, with the highest emission factors being exhibited by the pine needles for mutagenicity and eucalyptus for lung toxicity. These results demonstrate that (1) the different fuel types and combustion phases can dramatically alter the emissions characteristics, mutagenicity, and lung toxicity; (2) the present combustion system can be used for health-risk assessment from inhalation exposure to various types of wildfire smoke; and (3) smoldering emissions produce greater toxicity emission factors than do flaming emissions. [Abstract does not represent official USEPA policy.]